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CHARACTERIZATION OF PERCHLORATE CONTAMINATION UPDATE AUGUST 1999*

** This information supplements information in the
June 1999 EPA Region 9 Perchlorate Update fact sheet*

Interagency Perchlorate Steering Committee

- The EPA's work to assess the potential affects to human health and the environment from perchlorate has been greatly enhanced through collaboration with its partners in the Interagency Perchlorate Steering Committee (IPSC). The IPSC, jointly chaired by the EPA and the Department of Defense (DoD), was formed in January 1998 and now has representatives from 23 different federal, tribal, state, and local government agencies. Its purpose is to ensure an integrated approach to framing perchlorate issues and to inform and involve stakeholders about developments in the technical and regulatory arenas. Standing subcommittees are devoted to health/toxicology, occurrence, ecotoxicology/transport and transformation, analytical methods, treatment technologies, and communication. The members of the IPSC, as of August 1999 include: United States Environmental Protection Agency, Department of Defense, Agency for Toxic Substances and Disease Registry, National Institute for Environmental Health Sciences, National Aeronautics and Space Administration, Bureau of Indian Affairs, National Park Service, National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, U.S. Geological Survey, Arizona Department of Environmental Quality, Arizona Department of Health Services, California Department of Health Services, Nevada Division of Environmental Protection, Texas Natural Resources Conservation Commission, Utah Department of Environmental Quality, Utah Department of Health Laboratories, Cocopah Indian Tribe, Colorado River Indian Tribes, Ft. Mojave Indian Tribe, Chemehuevi Indian Tribe, Quechan Indian Tribe, City of Santa Clarita, California.

Toxicology and Ecotoxicology Assessment Schedule

- EPA's National Center for Environmental Assessment (NCEA) released an external review draft (ERD) of an assessment entitled *Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization Based on Emerging Information* in December 1998. This ERD was reviewed at an external peer review workshop held in February 1999.
- The ERD proposed an updated human health risk assessment as well as a screening-level ecological assessment on newly performed studies on the toxicity of perchlorate. The proposed revised human oral health risk benchmark harmonized noncancer and cancer approaches to derive a single oral risk benchmark ("RfD") based on precursor effects for both neurodevelopmental effects and thyroid neoplasia.

- The external peer panel endorsed the approach but recommended to the EPA that additional human health and ecological studies be conducted to complete the assessment of perchlorate. The EPA expects to secure a commitment in the fall of 1999 from the DoD to fund the prioritized additional studies. These remaining studies are expected to be completed in the summer of 2000 and EPA will then issue its new assessment for another external peer review in the Fall of 2000.
- Because of remaining significant concerns and uncertainties that must be addressed in order to finalize a human health oral risk benchmark, the EPA Office of Research and Development (ORD) has recommended that the Agency's risk assessors and risk managers continue to use the standing provisional RfD range of 0.0001 to 0.0005 mg/kg-day for perchlorate-related assessment activities.
- Regardless of the potential source of human exposure, either directly in drinking water or by ingestion of affected food crops, the RfD estimate would be used to evaluate the potential toxicity. Evaluations of this nature need to address the uncertainties due to variability in the concentrations of the exposure sources and these are considerable. The relative contribution from these potential different sources (water, food) will be evaluated in the new assessment.
- Protocols for studies on bioaccumulation, a farm gate analysis (a study of whether perchlorate is in various crops potentially exposed via irrigation or fertilizer) and site-specific analyses of known contamination sites are under development in a collaborative effort between DoD and the EPA to address these uncertainties. Definitive characterization of the different soil factors, types of plants and growth conditions that effect uptake and the potential for accumulation are part of these studies.
- The DoD and the Perchlorate Study Group (a consortium of defense contractors and manufacturers) have funded the majority of the toxicological and ecological studies. Protocols for studies are reviewed in a collaborative effort by DoD and EPA scientists, as well as other external reviewers. EPA scientists then conduct independent data analysis and interpretation for the assessment. Together the protocols, data, and the assessment are the subject of external peer review.

Analytical Methods to Detect Perchlorate

- An interlaboratory validation study of ion chromatography (IC) methods to detect perchlorate in water was released by the IPSC in April 1999. The current limit of detection for this method is 4 ppb. EPA is evaluating three different IC columns (AS-5, AS-11, and AS-16) to ascertain the effect of interferences, leading to development of a new method (EPA Method 309) that will serve as the basis for detection in future monitoring.

- Other analytical techniques include Raman spectroscopy and capillary electrophoresis. Development and validation of these methods will be useful to characterizing perchlorate in soils or plants and animal tissues so that transport and transformation studies can be done to track and characterize perchlorate contamination in various media.

Perchlorate in Fertilizer and Soil

- Perchlorate contamination has been thought to occur principally from the manufacture and use of perchlorate in solid rocket propellant and other pyrotechnics. The source of perchlorate in fertilizers is unknown and is being investigated. The potential for this new source to contaminate soil or to transport into water resources has not yet been characterized.
- EPA is participating with DoD, industry and private laboratories to evaluate the occurrence of perchlorate in commercial and household fertilizers. Preliminary results indicate that perchlorate levels can vary significantly between fertilizer brands and formulation types. Significant variations between different lots have been demonstrated, and this suggests either variations in production practices or perchlorate levels in the raw materials. Characterization of these variabilities and of methodological differences across the participating laboratories is not complete. A final report of the study will be available from the Air Force Research Laboratory on November 1, 1999.
- The EPA's National Exposure Research Laboratory (NERL) has completed preliminary studies suggesting uptake in vegetation from fertilizer containing perchlorate. These studies show that leafy garden crops, lettuce (*Lactuca sativa*) and mustard (*Brassica alba*), uptake perchlorate and its transformation products in their leaves, stems, and roots. Final results have not been tabulated and additional experimental work is needed to confirm these preliminary findings. Additional studies are also required to determine if accumulation occurs, under what soil and growth conditions, and in what types of plants or animals. Protocols for these studies are under development in a collaborative effort through the IPSC and await funding.
- NERL also examined if soil type affects adsorption (binding) of perchlorate and found that organic rich soils adsorbed significantly higher amounts of perchlorate as compared to sandy soils. The adsorption was strongly influenced by pH and concentration of perchlorate. Perchlorate is a reactive chemical, but appears to be stable in water, sediment and soil. In the environment, it is known to sorb, and research is currently underway to determine if it migrates into ground water. Bacteria isolated from the rhizosphere have been shown to degrade perchlorate to chloride.

Uptake of Perchlorate by Plants

- NERL has also completed preliminary experiments to evaluate if plants will uptake perchlorate in water. The objectives of these studies were to: identify what types of plants will uptake perchlorate in water, understand where in the plant perchlorate is found after uptake (i.e. in roots, leaves etc.), and whether or not perchlorate would remain in plants over a limited amount of time. These factors are important to understanding if perchlorate in plants might represent an exposure potential as well as identifying plant species for use in treatment of soil, groundwater or surface water containing perchlorate (phytoremediation).
- Lettuce seedlings were grown over approximately 24 days in water only (hydroponic) containing a range of concentrations of perchlorate. These individual experiments suggest that perchlorate can bioaccumulate by a factor of approximately 350 in the leaves. These initial results should not be extrapolated to actual farm growing conditions, or to other crop species because the experimental designs were preliminary and limited. The different conditions that might effect uptake and potential accumulation such as the variability in the fertilizer content, different types of soil, growth conditions and types of plants have not been characterized.

Monitoring and Regulatory Activities

- EPA will continue to collect information about perchlorate occurrence from its regional offices, water suppliers, IPSC member agencies, and others. This information is critical to understanding if and where exposures to perchlorate are taking place in the United States. EPA is also coordinating efforts with DoD and State environmental offices to determine the extent of perchlorate use and potential releases at Federal facilities. The IPSC has named a subcommittee devoted to characterizing occurrence.
- Both the EPA and the United States Department of Agriculture (USDA) are interacting on ensuring that the potential for contaminated food sources is being investigated. The USDA is joining the IPSC and will be helping to steer future activities. The DoD, EPA and USDA will collaborate on the protocols to evaluate the potential source contribution from the food supply.
- The EPA Office of Water (OW) will continue to acquire data from implementation of the Unregulated Contaminant Monitoring Rule to make determinations of the source contribution from water. The OW and the United States Geological Survey (USGS) are developing some surveys in collaboration with the IPSC. The American Water Works Association Research Foundation (AWWARF) has also conducted a survey and results are expected in the Spring of 2000.

- There is currently no federal National Primary Drinking Water Regulation for perchlorate. It is on the Safe Drinking Water Act's Contaminant Candidate List (CCL), but before a determination to regulate can be made, data gaps must be filled regarding occurrence and sources, health effects, analytical methods, and treatment technology options. The EPA will issue a health advisory once the final harmonized "RfD" is established. Finding these answers to perchlorate is a very high priority in the EPA.

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